



Using AIRS Moisture Retrieval Data to Derive Atmospheric Motion Vectors

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AIRS Science Team Meeting

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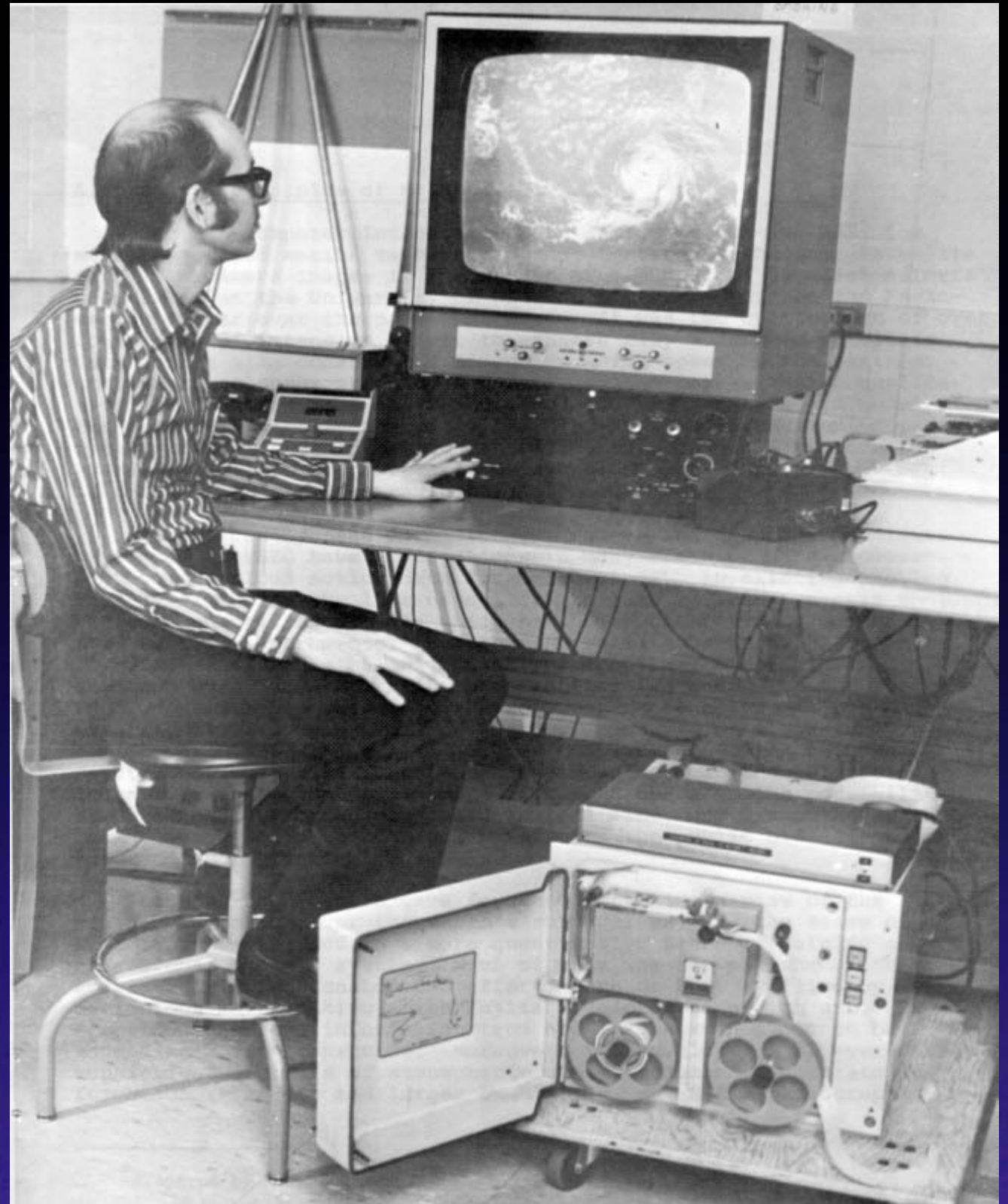
Outline

- 1) History of the Polar Winds project
 - a) MODIS
 - b) AVHRR
- 2) Applying to images of retrieved moisture
 - a) Data coverage
 - b) Issues
- 3) Preliminary data assimilation impact
- 4) Future

Satellite-derived Winds Heritage

The Beginning

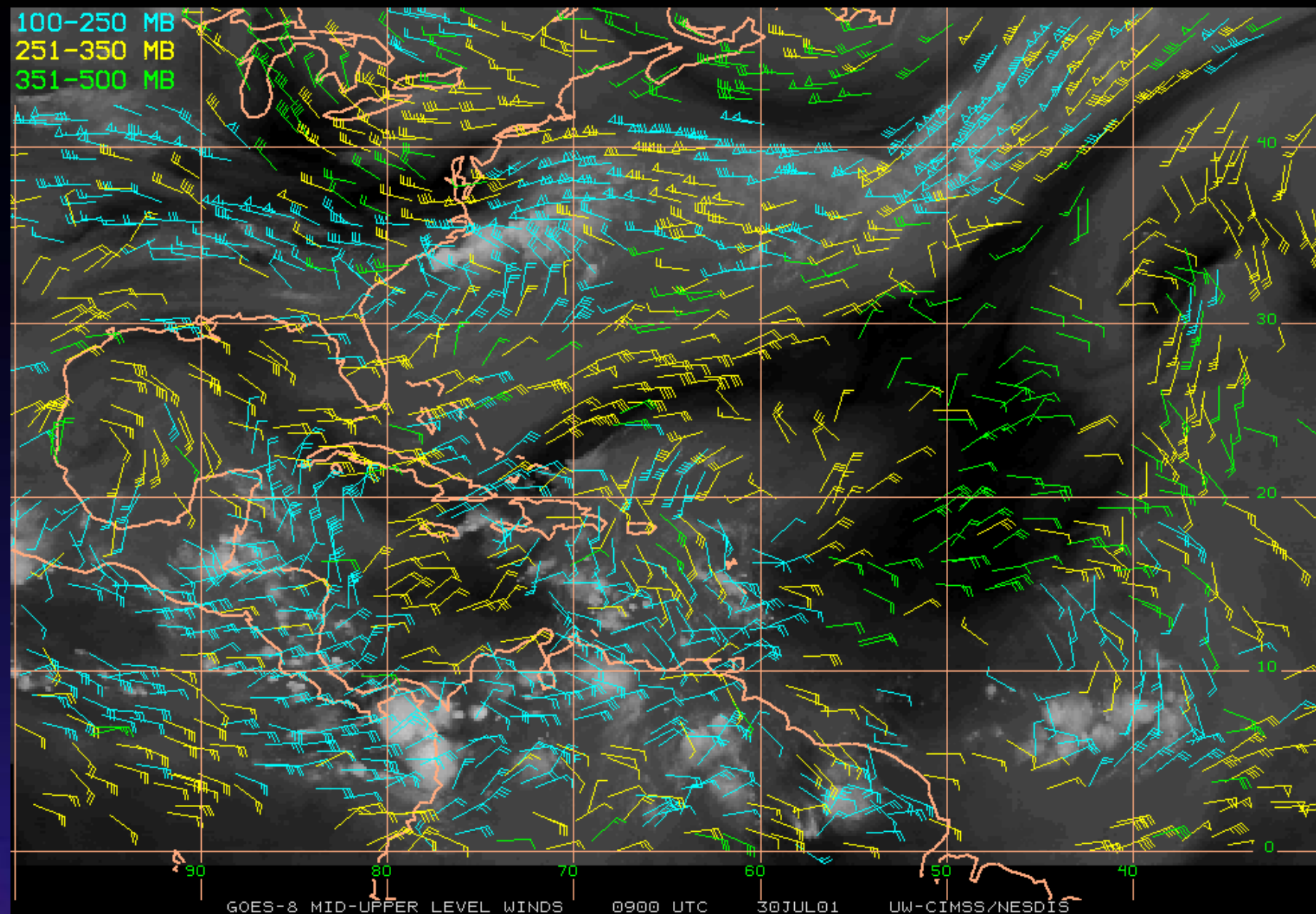
- 1970s: The first series of geostationary weather satellites
- Manual targeting and tracking
- Manual quality control
- Window channel height assignment based on brightness temperature



Satellite-derived Winds Heritage

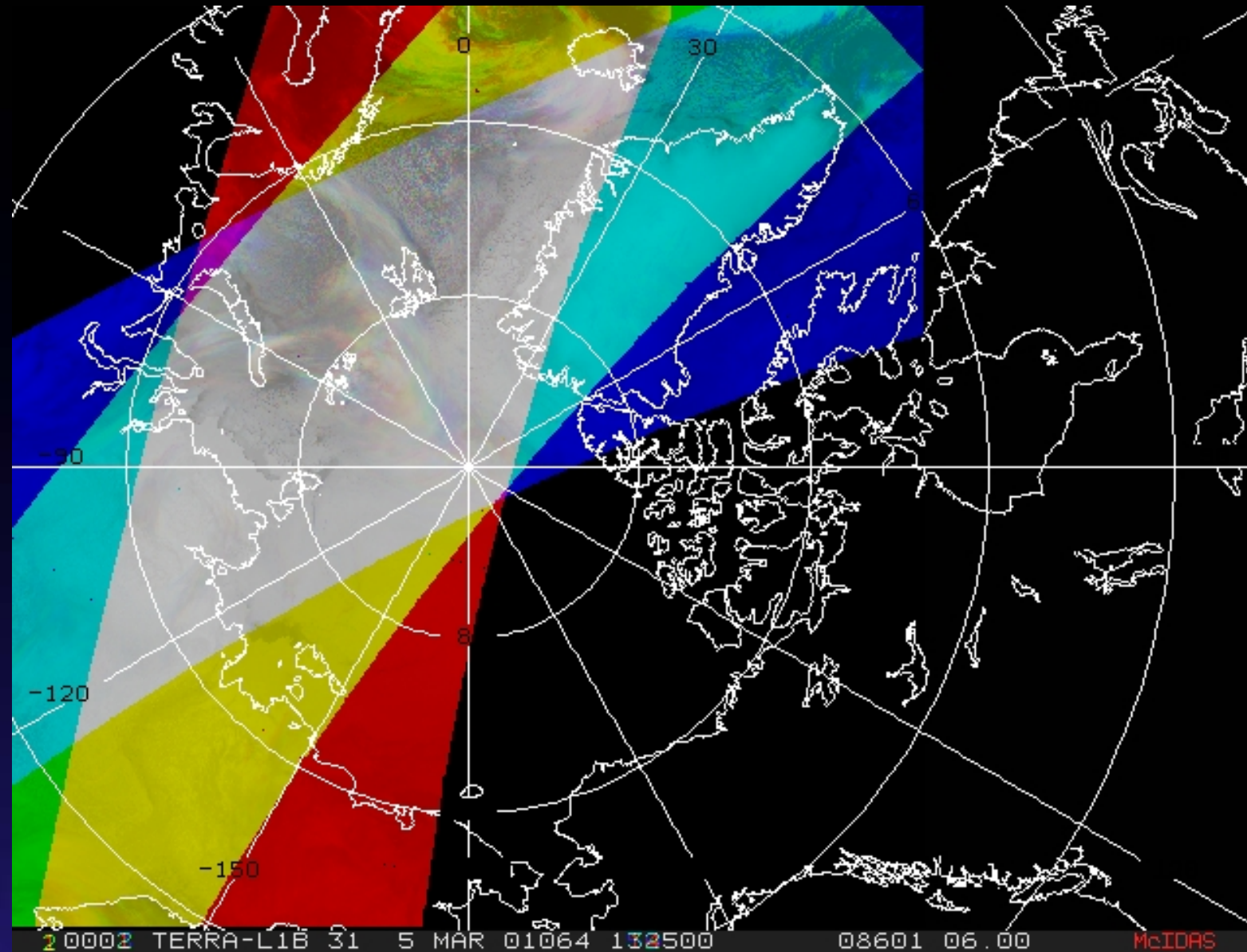
Geostationary Satellites

- The polar winds work is built on the long history of geostationary wind retrievals at CIMSS.
- The geostationary method is based on cloud and water vapor feature tracking.
- The geostationary wind code has been adapted and extended for use with polar orbiting satellites.



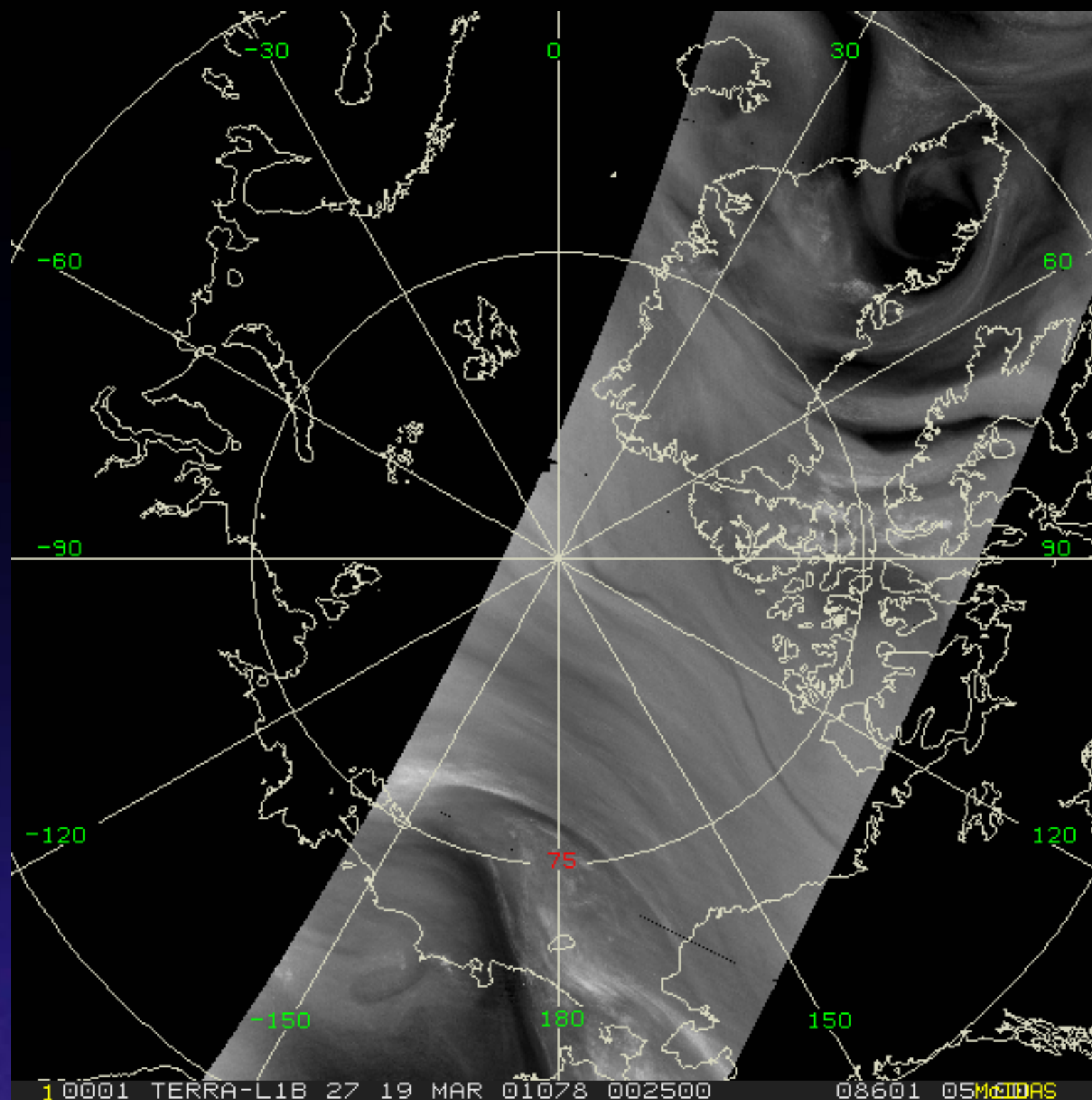
Satellite-derived Winds Heritage

Polar Satellites



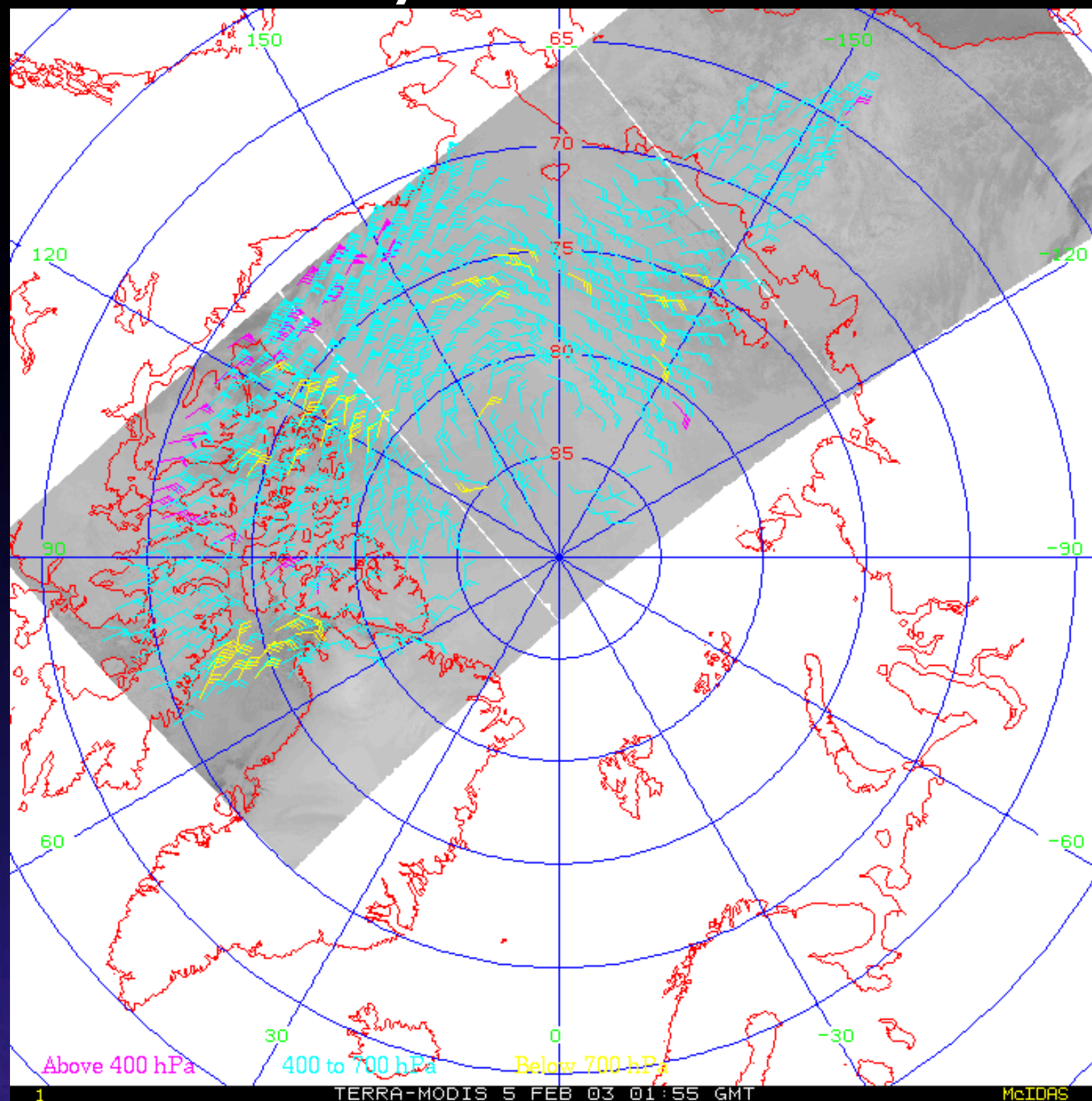
Unlike geostationary satellites at lower latitudes, it is not possible to obtain complete polar coverage at a snapshot in time. Winds must be derived for areas that are covered by two or three successive orbits, an example of which is shown here. The gray area is the overlap between three orbits.

One Day of Arctic Orbits



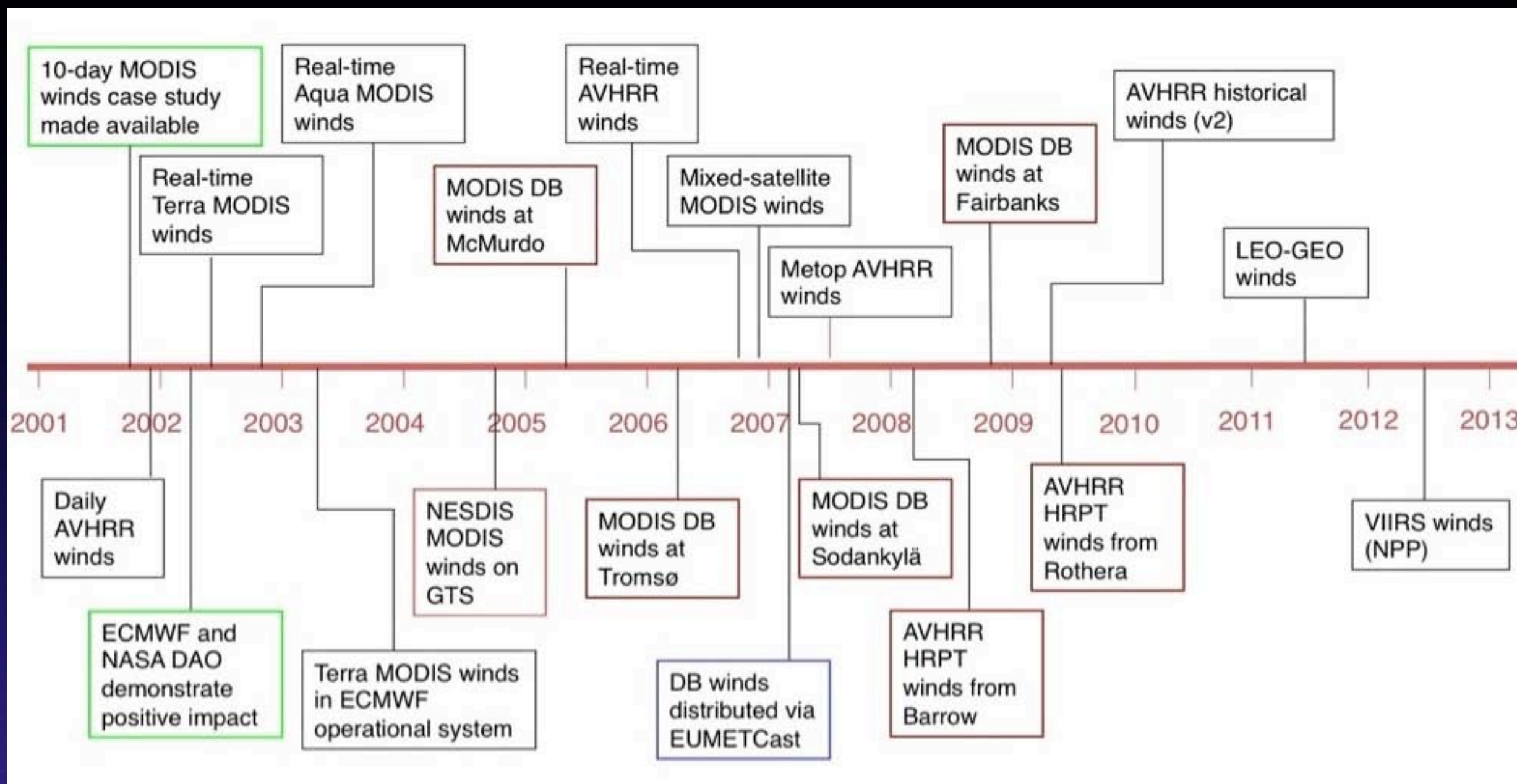
MODIS band 27 ($6.7 \mu\text{m}$)

One Day of Arctic Orbits



MODIS band 31 ($11 \mu\text{m}$)

Polar Winds Product History





Polar Winds in Numerical Weather Prediction

European Centre for Medium-Range Weather Forecasts (ECMWF)

NASA Global Modeling and Assimilation Office (GMAO)

Japan Meteorological Agency (JMA), Arctic only

Canadian Meteorological Centre (CMC)

US Navy, Fleet Numerical Meteorology and Oceanography Center (FNMOC)

(UK) Met Office

Deutscher Wetterdienst (DWD)

National Centers for Environmental Prediction (NCEP/EMC)

Meteo France

Australian Bureau of Meteorology (BoM)

National Center for Atmospheric Research (NCAR, USA)

China Meteorological Administration (CMA)

Hydrological and Meteorological Centre of Russia (Hydrometcenter)

Tracking humidity features from AIRS retrievals

Project Overview

- Determine to what extent AIRS-derived AMVs can provide useful wind information. Advantages:
 - a) Provide a 3-dimensional winds dataset
 - b) Removes issues with AMV height determination
 - c) Clear sky (and above cloud) wind information
 - d) No water vapor imager channel after MODIS (polar orbiter)
- Use the CIMSS SFOV AIRS retrieval algorithm
 - a) Need highest possible resolution

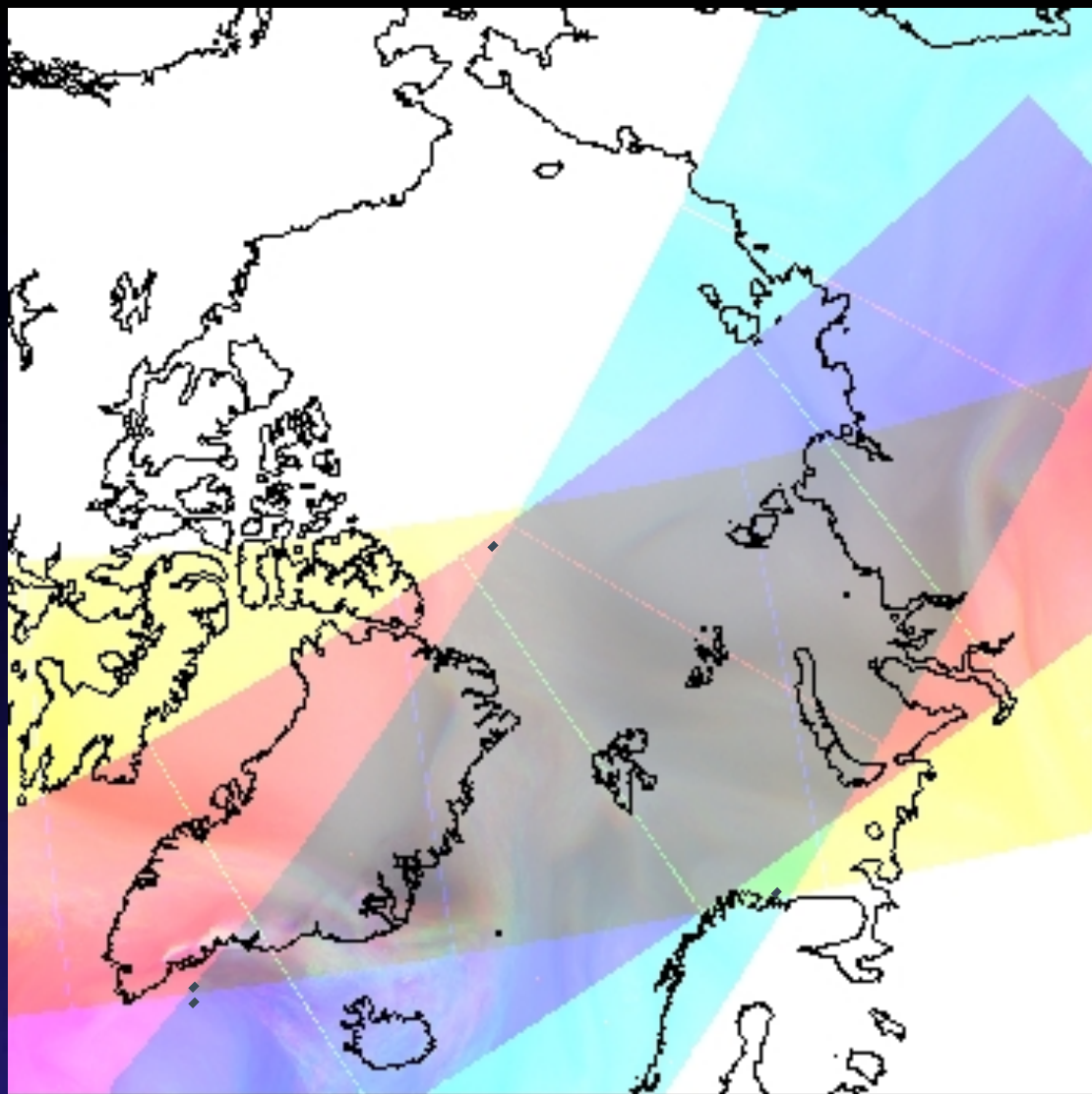
Tracking humidity features from AIRS retrievals

Project Overview

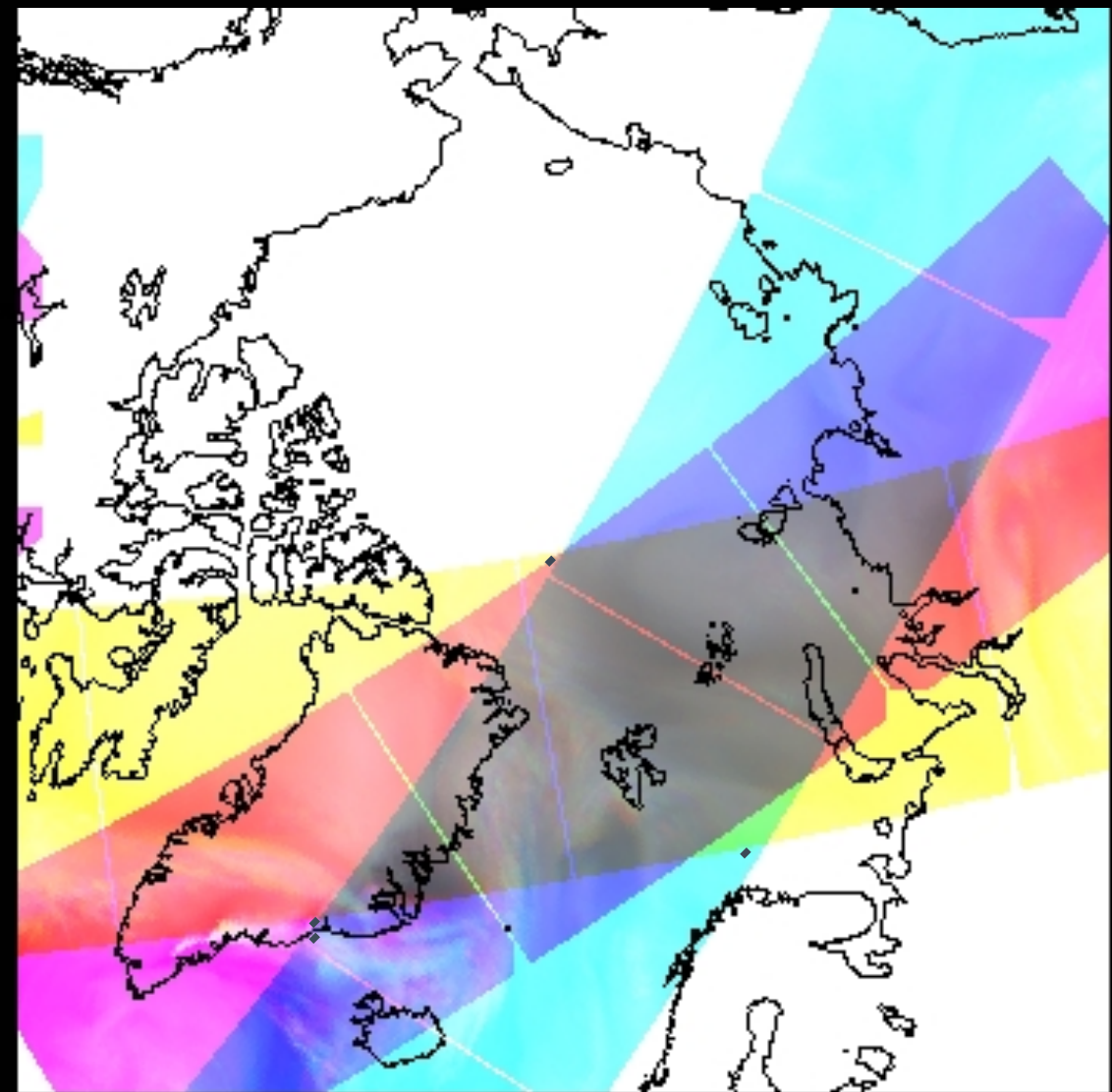
- Blend the AIRS moisture retrieval AMVs with MODIS AMVs to create 3-D polar wind fields.
- Perform NWP experiments with the blended product to determine the overall impact on numerical forecasts, and the relative contributions of each data type (MODIS vs. AIRS).

Polar Winds Coverage

MODIS vs. AIRS

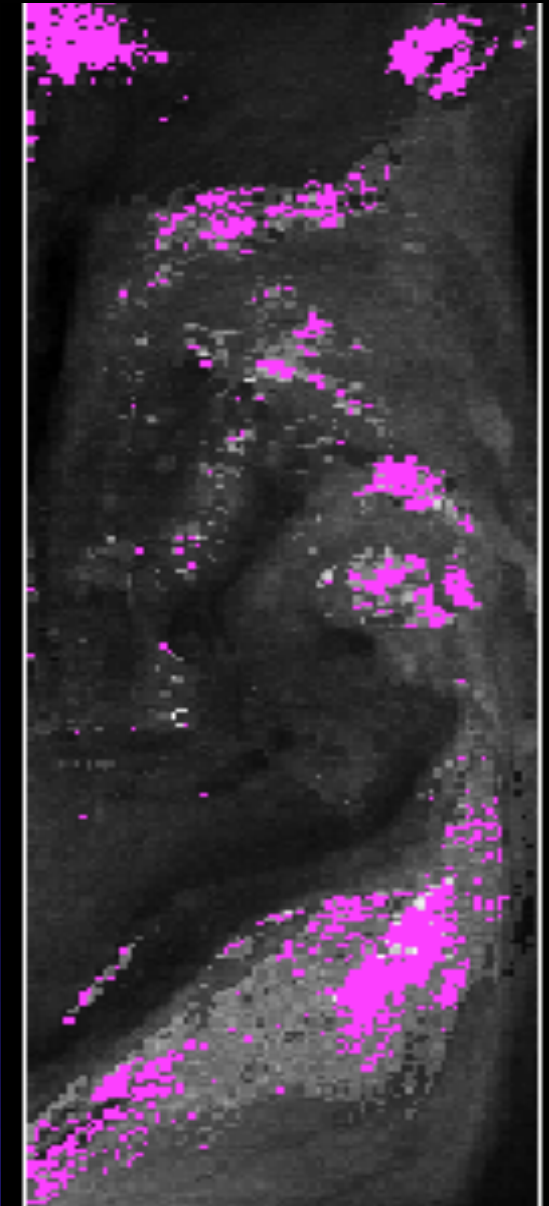


AQUA MODIS COVERAGE

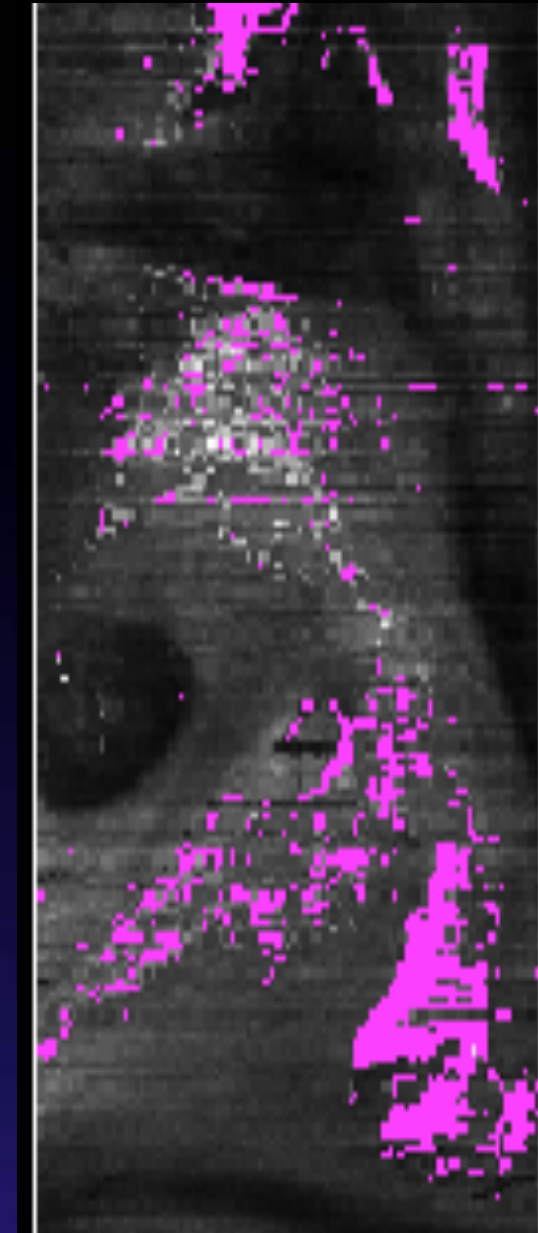


AQUA AIRS COVERAGE

Sensors Degrading?



01 Jan 2005



08 Jan 2011

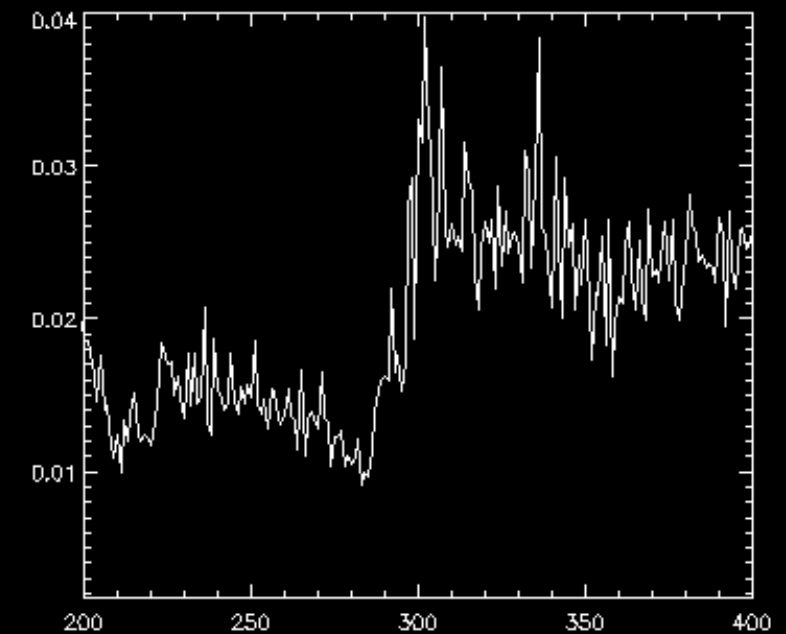
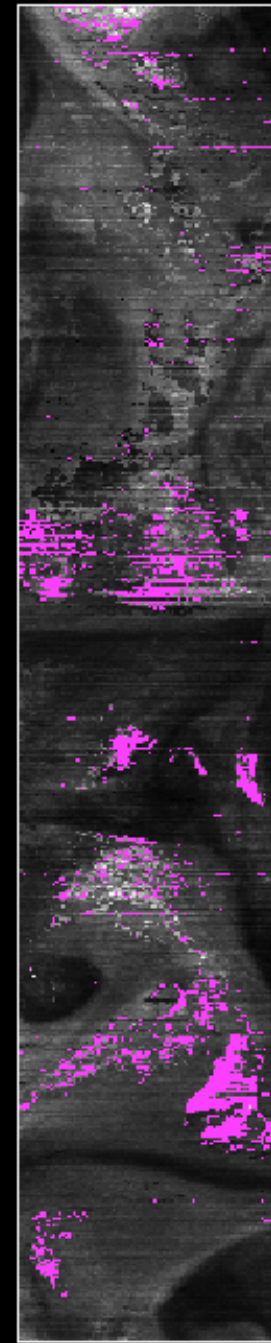
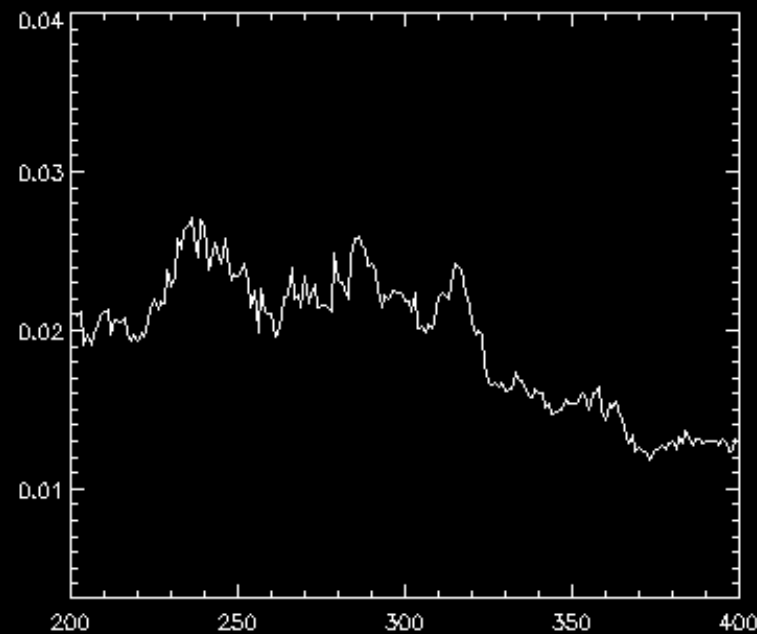
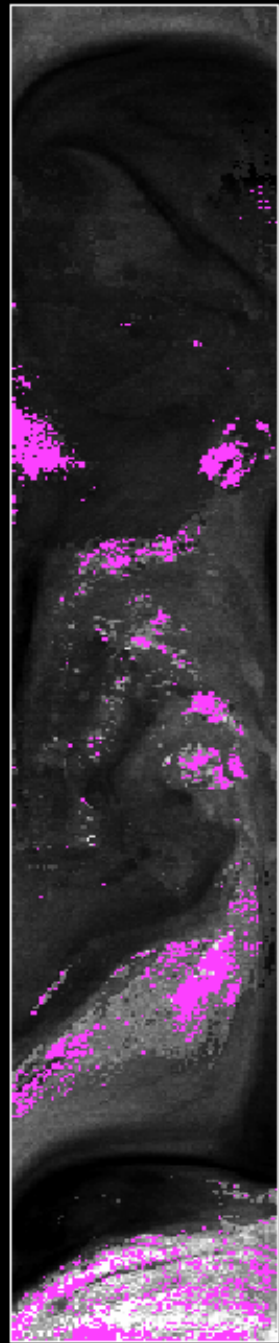
AIRS moisture 300 hPa over polar region; clouds in cyan

Sensors Degrading?

Line average

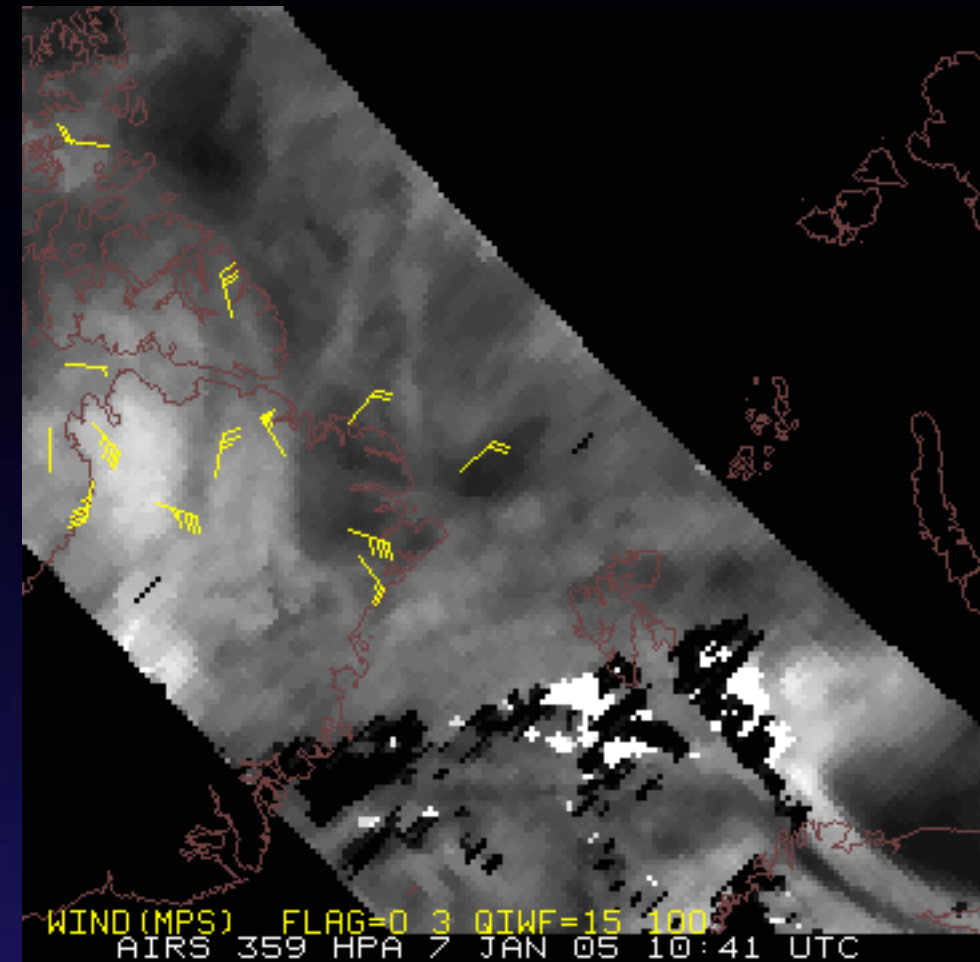
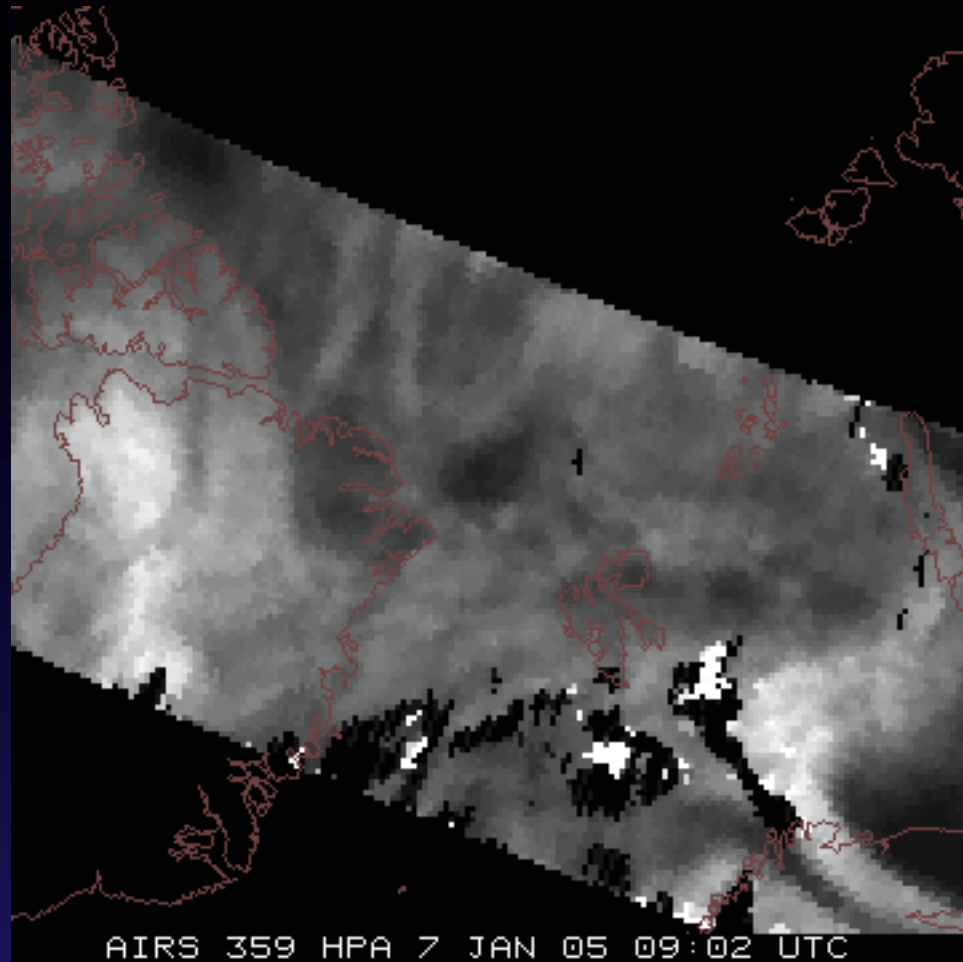
01 Jan 2005

08 Jan 2011



AIRS moisture 300 hPa over polar region; clouds in cyan

AIRS Retrieval Images at 359 hPa

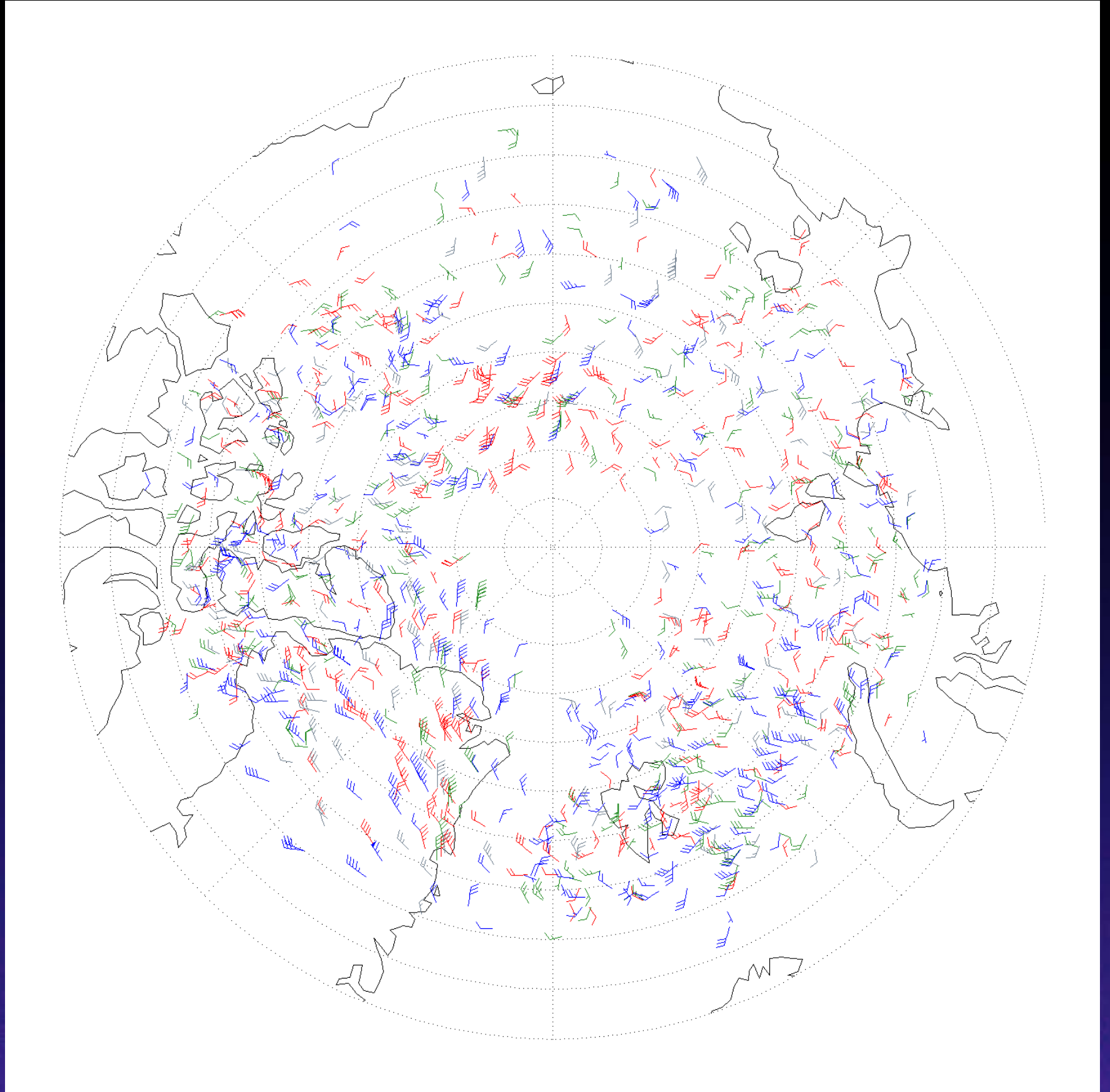


Specific humidity SFOV AIRS retrievals
Remapped composites at 16 km resolution

Spatial distribution of AIRS retrieval winds for one day. North Pole region.

All derived winds from 5 January 2011. Color coded by level:

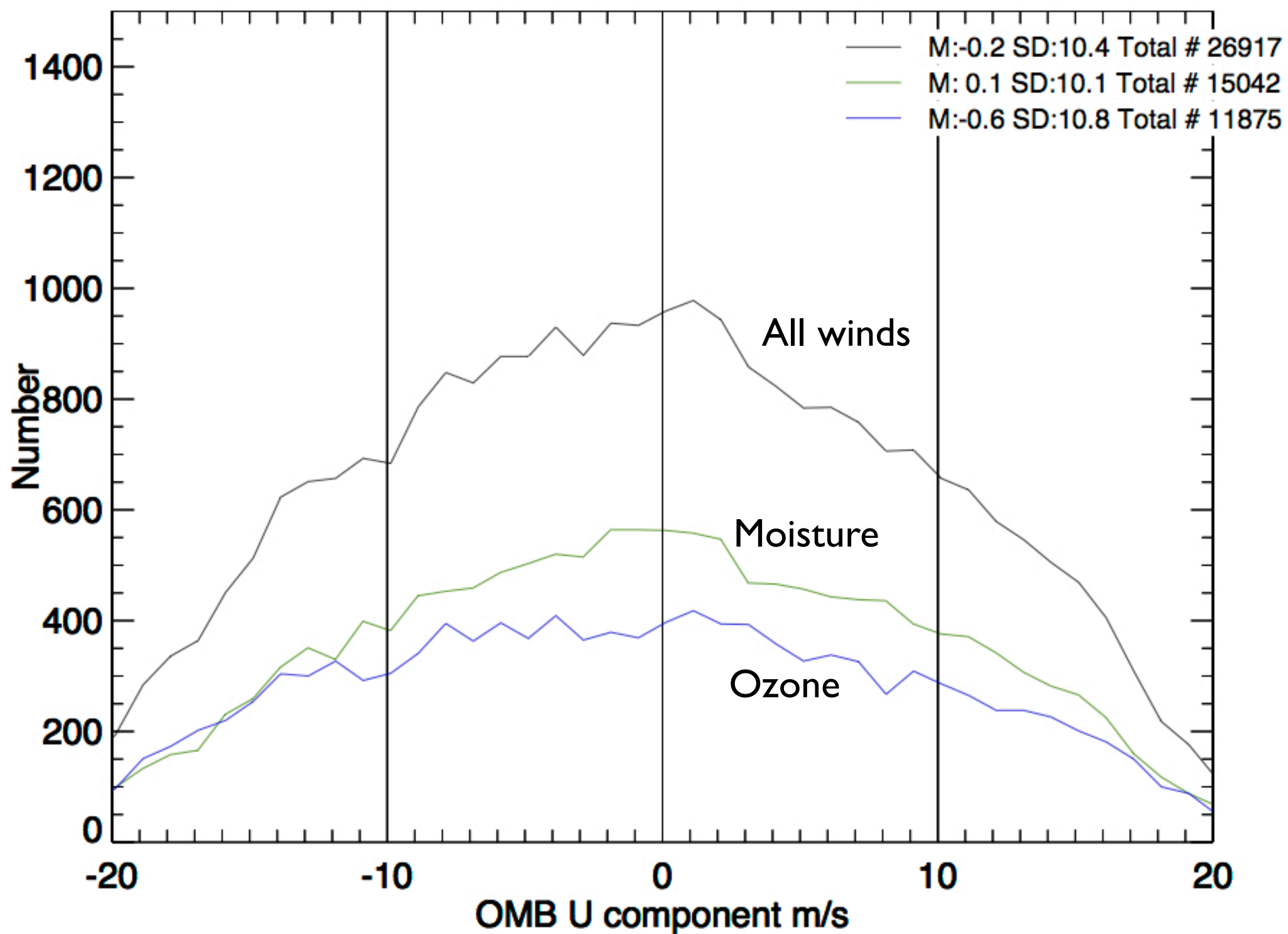
- 700 - 600 hPa (red)
- 550 - 450 hPa (green)
- 400 - 300 hPa (blue)
- 150 hPa ozone (gray)



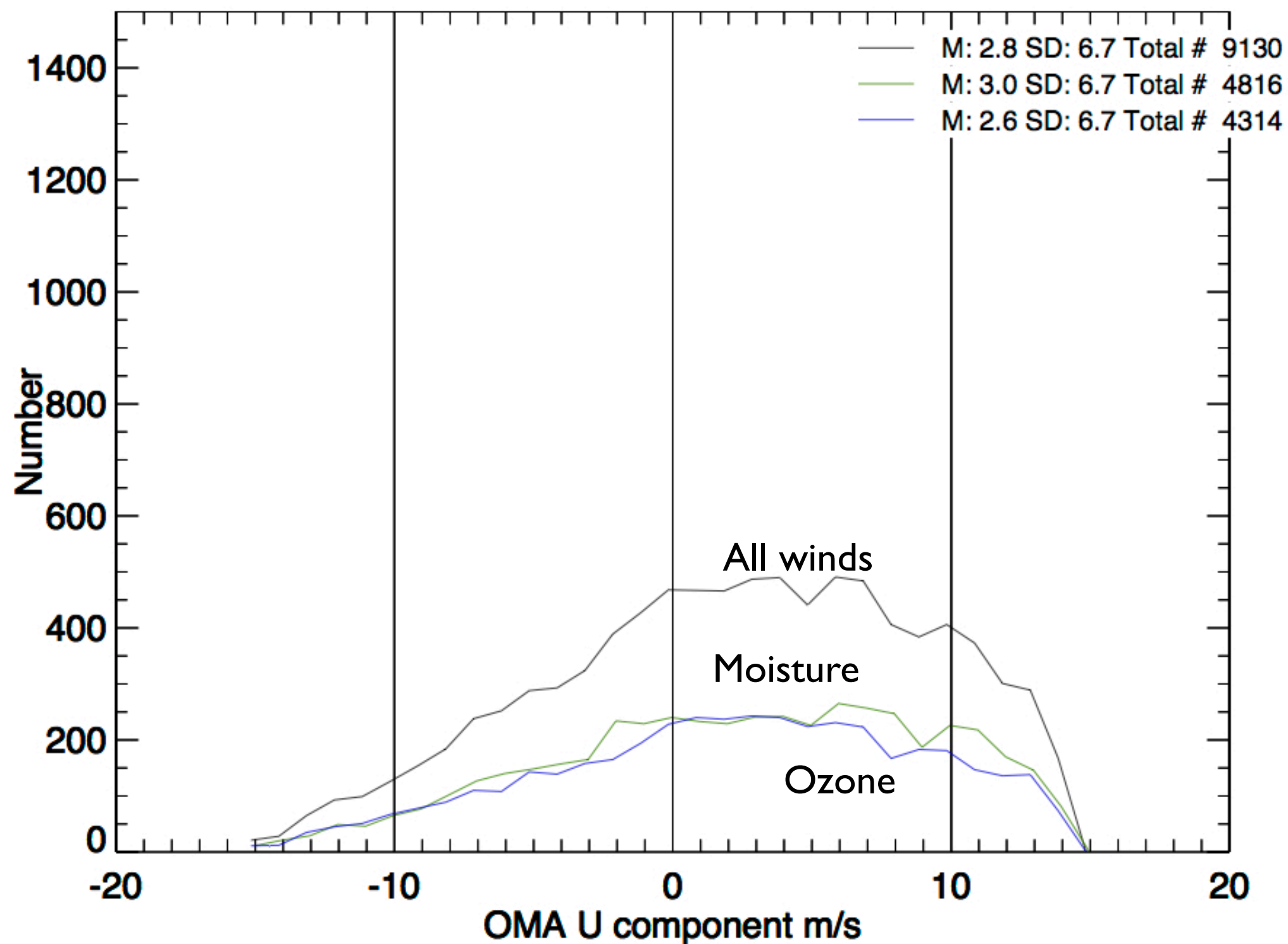
Assimilation

- 1) Two weeks: 01 – 14 January 2011
- 2) Northern Hemisphere
- 3) 29 levels: 12 ozone and 17 moisture levels (away from tropopause)
 - Ozone: 103 - 201 hPa
 - Moisture: 359 – 661 hPa
- 4) 2010 version of GSI
- 5) All winds; no quality control

Assimilation



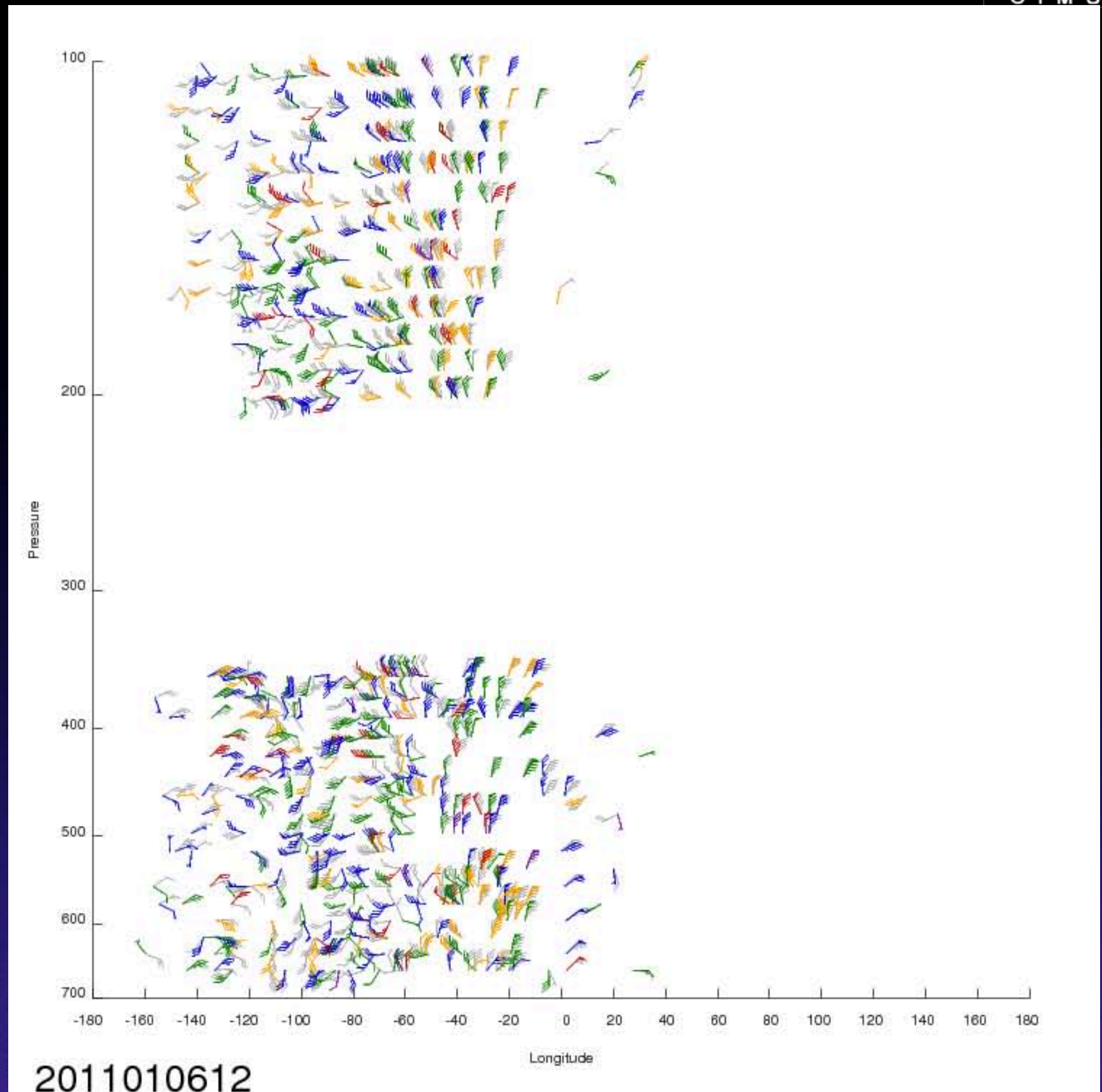
Assimilation



Vertical distribution of AIRS retrieval winds used. North Pole region.

All derived winds from 6 January 2011 at 1200 UTC.

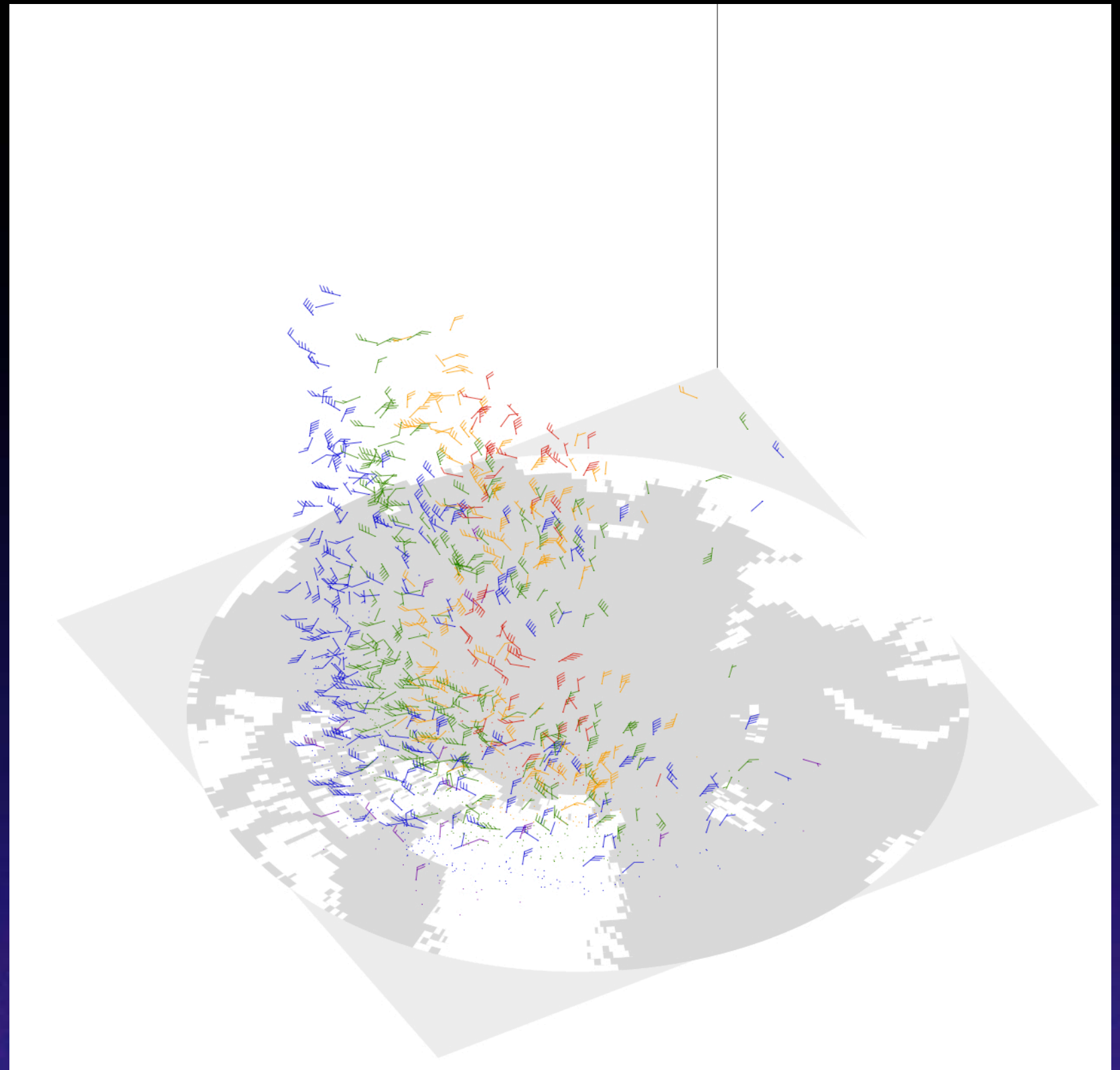
Colors denote distance from pole: blue (far) to red (close). Gray is the analysis.



Vertical distribution of AIRS retrieval winds used. North Pole region.

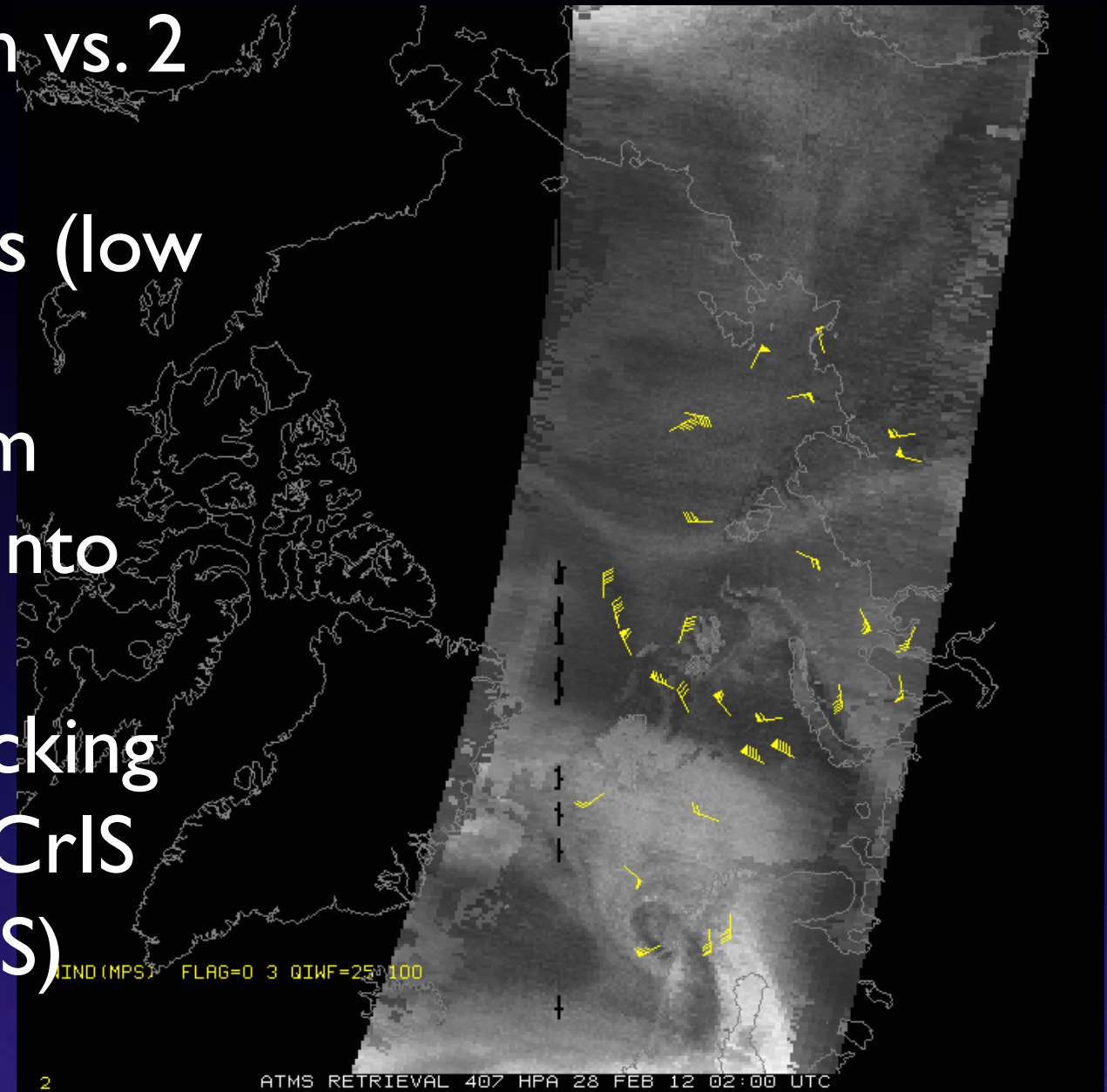
All derived winds from 6 January
2011 at 1200 UTC.

Colors denote distance from pole:
blue (far) to red (close). Gray is
the analysis.



Status

- New challenges:
 - Lower resolution: 16 km vs. 2 km for MODIS
 - Noise in SFOV retrievals (low pass and median filters)
- Fine tuning winds algorithm
- Preparing for assimilation into GEOS-5
- Use this AIRS retrieval tracking method for IASI (Metop); CrIS and ATMS (Suomi NPP, JPSS)



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